

84 grooves successively by the first and second marking rolls and then form a cylindrical pipe by roll forming by the roll forming device.

REMARKS

Applicants thank the Examiner for the very thorough consideration given the present application. Claims 1-7 are currently being prosecuted. The Examiner is respectfully requested to reconsider his rejections in view of the amendments and remarks as set forth hereinbelow.

Claim for Priority

It is gratefully acknowledged that the Examiner has recognized Applicants' claim for foreign priority. In view of the fact that Applicants' claim for foreign priority has been perfected, no additional action is required from the Applicants at this time.

Drawings

The Official Draftsperson has not approved the formal drawings submitted by the Applicants. It is respectfully submitted that the drawings comply with the requirements of the U.S.P.T.O. If the Official Draftsperson has any objections to the formal drawings, he is respectfully requested to contact the undersigned as soon as possible so that appropriate action may be taken. No further action is believed to be necessary at this time unless the undersigned receives a Notice from the Official Draftsperson.

Acknowledgement of Information Disclosure Statement

The Examiner has acknowledged the Information Disclosure Statement filed December 8, 2000. An initialed copy of the PTO 1449 form has been received from the Examiner. No further action is necessary at this time.

Art Rejection Under 35 U.S.C. § 102 and 103

Claim 1 stands rejected as being anticipated by Ishikawa et al., Japanese Publication No. 10-47880 or Japanese Publication No. 10-206060. Claims 6 and 7 stand rejected under 35 U.S.C. § 102 as anticipated by Takashi et al., Japanese Publication No. 11-90530. Claims 2 and 3 are rejected as being obvious over Ishikawa et al. in view of Takashi et al. Claims 4 and 5 stand rejected under 35 U.S.C. § 103 as being obvious over Ishikawa et al. in view of Shikazono et al., U.S. Patent No. 5,803,165. These rejections are respectfully traversed.

All of the claims have been amended by way of the present Amendment so as to better specify the invention. It is respectfully submitted that the prior art cited by the Examiner does not show each and every feature now defined by the claims. Accordingly, the Examiner's rejections based on 35 U.S.C. § 102 and 103 have been obviated.

The Examiner rejected claim 1 as being anticipated by Ishikawa et al. However, claim 1 sets forth a combination of elements wherein the grooves in the two rows form V-shaped patterns. In Ishikawa et al. '880, the two rows of grooves do not form V-shaped patterns, that is, the grooves do not meet at the boundary lines between the different rows. Instead, they end randomly, and do not form V's. In Ishikawa et al. '060, the rows are separated with ungrooved regions and thus, the rows do not contact

each other at all. Accordingly, Applicants submit that claim 1, as amended, now is patentable over these references.

The Examiner rejected claims 6 and 7 as being anticipated by Takashi et al. Both claims 6 and 7 require that the two rows of grooves have different widths in a circumferential direction. While Takashi et al. shows V-shaped grooves, they do not show the arrangement where the two rows have different widths. Accordingly, claims 6 and 7 define over this reference.

Claims 2 and 3 were rejected as being obvious over Ishikawa et al. in view of Takashi et al. The Examiner admits that the primary reference does not show the secondary grooves, and relies on the secondary reference to teach the presence of secondary grooves. However, neither of the references teach the idea of two rows of grooves forming V-shaped patterns, and having different widths in their circumferential direction. Accordingly, even if one skilled in the art, would find it obvious to add the secondary grooves of Takashi et al. to the device of Ishikawa et al., there still is no teaching of two rows forming V-shaped patterns, and having different widths. Accordingly, claims 2 and 3 are patentable over this combination of references.

Claims 4 and 5 were rejected as being obvious over Ishikawa et al. in view of Shikazono et al. The Examiner admits again that Ishikawa et al. lacks secondary grooves, and relies on Shikazono et al. to show the secondary grooves. However, neither of the references teach the concept of having two rows of grooves forming V-shaped patterns where the rows have different widths. Further, the Shikazono et al. reference does not disclose secondary grooves which extend from one side surface of the projected portions, to the other side surface. Accordingly, Applicants submit that these claims are also patentable over this combination of references.

Several advantageous effects evolve from the present invention. Since the two rows of grooves form symmetrical V-shaped patterns, ends of the grooves are continuously connected. Accordingly, refrigerant becomes joined, or split at the ends of the various grooves. This works more effectively than the prior art, where the groove ends are not connected, thus improving the heat transfer of the refrigerant. The grooves allow the refrigerant to flow spirally, since they are arranged diagonally to the axial direction of the pipe. This increases the transfer distance so that the heat transfer is improved. Because the grooves of one row are narrow and the adjoining grooves broad, the narrower row causes the refrigerant to be agitated. This allows further heat transfer. In addition, the surface patterns on a row for forming the V-shaped grooves into the pipe surface can be simplified, and strongly structured because the groove ends are connected continuously to the neighboring groove ends. Thus, additional advantages are obtained by this arrangement.

CONCLUSION

In view of the above remarks, it is believed that the claims clearly distinguish over the patents relied on by the Examiner, either alone or in combination. In view of this, reconsideration of the rejections and allowance of all of the claims are respectfully requested.

Since the remaining patents cited by the Examiner have not been utilized to reject the claims, but to merely show the state of the art, no comment need be made with respect thereto.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Mr. Robert F. Gnuse (Reg. No. 27,295) at the

telephone number of the undersigned below, to conduct an interview in an effort to expedite prosecution in connection with the present application.

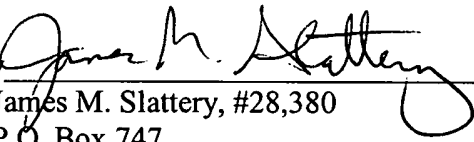
Pursuant to 37 C.F.R. §§ 1.17 and 1.136(a), Applicants respectfully petition for a two month extension of time for filing a response in connection with the present application and the required fee of \$400.00 is being filed concurrently herewith.

Attached hereto is a marked-up version of the changes made to the application by this Amendment.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

Respectfully submitted,

BIRCH, STEWART, KOLASCH & BIRCH, LLP

By 
James M. Slattery, #28,380
P.O. Box 747
Falls Church, VA 22040-0747
(703) 205-8000

JMS/RFG/ags

Attachment: Version with Markings to Show Changes Made

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

The paragraph on page 14, lines 1-11 has been amended to read as follows:

--The lead angle θ , the groove depth H and the groove number N of the grooves 3 formed in the V-shaped patterns, the first to fifth groups A - E of which are arranged in the inner surface of the [pile] pipe, are set to the values by which the smallest flow resistance is obtained corresponding to the aforementioned experiment results. Therefore, since the flow resistance can be made as small as possible to reduce the pressure loss as a result, a heat-transfer pipe for a heat exchanger having a sufficiently high performance can be obtained.--.

The paragraph on page 17, line 12, and continuing onto page 18, line 1, has been amended to read as follows:

--The lead angle θ , the groove depth H and the groove number N of the grooves 3 formed in the V-shaped patterns, the first to fifth groups A - E of which are arranged in the inner surface of the [pile] pipe, are set to the values by which the smallest flow resistance is obtained. In addition, the secondary grooves 6 are formed in the projected portions 5 provided between the respective grooves 3 as main grooves in V-shaped patterns and the secondary grooves 6 are notched grooves from the top 5a towards the base 5b of the projected portions 5 and are directed in the spiral direction. Therefore, since the flow resistance can be made as small as possible to reduce the pressure loss and swirling force in the spiral direction can be further increased, a heat-transfer pipe for a heat exchanger having a still higher performance can be obtained.--

The paragraph on page 21, lines 9-24 has been amended to read as follows:

--The lead angle θ , the groove depth H and the groove number N of the grooves 3 formed in the V-shaped patterns, the first to fifth groups A - E of which are arranged in the inner surface of the [pile] pipe, are set to the values by which the smallest flow resistance is obtained. In addition, the secondary grooves 7 composed of fine grooves are formed from one side of an outer surface of the projected portion 5 to the other side thereof to direct toward, for example, the spiral direction. Therefore, since the flow resistance can be made as small as possible to reduce the pressure loss and swirling force in the spiral direction can be further increased, a heat-transfer pipe for a heat exchanger having a still higher performance can be obtained. Also, even when the pipe is expanded, the fine grooves on the side portions are not crushed and thereby the heat transfer performance is not deteriorated.--

IN THE CLAIMS:

Claims 1-7 have been amended as follows:

1. (Amended) A heat-transfer pipe provided with internal grooves, [wherein]
comprising:

a pipe body;

a plurality of rows of grooves including a first row of parallel grooves and a second row of parallel grooves on an inner surface of the pipe body, wherein

the parallel grooves in the first row and the parallel grooves in the second row
[arranged in] form V-shaped patterns [(3) symmetric] symmetrically with respect to a pipe axis
direction, and

the first row and the second row are different in width in a circumferential direction
of the pipe body [are provided on an inner surface (2) of the pipe body (1a); and widths, of the
plurality of rows of the grooves (3) arranged in the V-shaped patterns are made unequal in a
circumferential direction].

2. (Amended) The heat-transfer pipe provided with internal grooves according to
claim 1, [wherein] further comprising:

secondary grooves, said secondary grooves [(6)] having a prescribed depth [are] formed from
a top [(5a)] side towards a base [(5b)] side at least in part of projected portions [(5)] formed between
respective grooves [(3)] of the plurality of rows of the grooves [(3)] arranged in the V-shaped
patterns.

3. (Amended) The heat-transfer pipe provided with internal grooves according to
claim 2, wherein [the] said secondary grooves [(6)] are notched grooves in a spiral direction.

4. (Amended) The heat-transfer pipe provided with internal grooves according to
claim 1, [wherein] further comprising:

secondary grooves, said grooves [(7)] having a prescribed depth [are] formed in an outer surface of at least part of projected portions [(5)] formed between respective grooves [(3)] of the rows of grooves [(3)] arranged in the V-shaped patterns.

5. (Amended) The heat-transfer pipe provided with internal grooves according to claim 4, wherein

[the] said secondary grooves [(7)] are fine grooves [(5)] extending from one side surface of the projected portions [(5)] to the other side surface thereof.

6. (Amended) A method for manufacturing a heat-transfer pipe provided with internal grooves, [wherein] comprising the continuous steps of:

[a first marking roll (11) for] marking a plurality of rows of grooves [(3)] arranged in V-shaped patterns in] including a first row of parallel grooves and a second row of parallel grooves on a flat, plate-like heat-transfer pipe material [(13)] by using a first marking roll, wherein

the parallel grooves in the first row and the parallel grooves in the second row form V-shaped patterns symmetrically with respect to a pipe axis direction, and

the first row and the second row are different in width in a circumferential direction of the pipe body;

[a second marking roll (12) for] marking secondary grooves [(7)] at least in part of projected portions [(5)] formed between respective grooves [(3)] of the plurality of rows of the grooves [(3)] which are arranged in the V-shaped patterns by using a second marking roll; and

[and a roll forming device (17) for] forming the flat plate-like heat-transfer pipe material [(13)] into a cylindrical pipe by using a roll forming device [are used to continuously mark the plurality of rows of the grooves (3) arranged in the V-shaped patterns and the secondary grooves (7) in the flat plate-like heat-transfer pipe material (13) successively by the first and second marking rolls (11), (12) and then form a cylindrical pipe by roll forming by the roll forming device (17)].

7. (Amended) A device for manufacturing a heat-transfer pipe with internal grooves, [wherein] comprising:

a first marking roll [(11)] for marking a plurality of rows of grooves including a first row of parallel grooves and a second row of parallel grooves [(3) arranged in V-shaped patterns] in a flat plate-like heat-transfer pipe material [(13)], wherein

the parallel grooves in the first row and the parallel grooves in the second row form V-shaped patterns symmetrically with respect to a pipe axis direction, and

the first row and the second row are different in width in a circumferential direction of the pipe body;

a second marking roll [(12)] for marking secondary grooves [(7)] at least in part of projected portions [(5)] formed between respective grooves [(3)] of the plurality of rows of the grooves [(3)] arranged in V-shaped patterns; and

a roll forming device [(17)] for forming the flat plate-like heat-transfer pipe material [(13)] into a cylindrical pipe,

wherein the first marking roll, the second marking roll and the roll forming device are provided successively side by side in a direction of movement of the flat plate-like heat-transfer pipe

material [(13)] so as to continuously mark the grooves [(3)] arranged in [the] V-shaped patterns and the secondary grooves [(7)] successively by the first and second marking rolls [(11), (12)] and then form a cylindrical pipe by roll forming by the roll forming device [(17)].